





Global Risks Perceptions Report 2021





SUSTAINABILITY



International Science Council

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Key Messages

~~	Scientists systematically ranked likelihood and impact of global risks higher than members of business and economic communities.
	All surveyed communities rated environmental risks among the most urgent global risks humanity faces today and as highly interconnected with other global risks.
((0))	Technological risks are now seen as more likely to occur, compared to earlier findings.
	Five risks emerge as most likely to form an interconnected cluster of risks and lead to a global systemic crisis: <i>failure to take climate action - biodiversity</i> <i>loss - infectious disease - extreme weather events - human environmental</i> <i>damage</i> .
	Scientists highlighted the need to prioritize inequality as a standalone risk in assessments and perception analyses.
	Business and science communities are only two groups of many more with perspectives relevant to dialogues about global risks. There is a continued need to learn from each other and build a global community around mitigating risks.

Introduction



Humanity is facing threats that demand we put aside challenges to global cooperation and take urgent, multilateral action. Inequity, compounded by environmental challenges and widespread digitalization, are rapidly changing the landscape of global risks. This has become more apparent over the last year and a half, marked indelibly by the global COVID-19 pandemic and its cascading effects, but also by rising intensity and severity of extreme events linked to climate change, such as wildfires, heatwaves, and tropical storms.

In this global setting, subject to such volatility, uncertainty, complexity, and ambiguity (VUCA) (see, e.g., <u>Bennett and Lemoine, 2014</u>), it is more imperative than ever to encourage efforts to better understand, prepare for, and act on global risks. The key to strategic risk management is first developing a more comprehensive understanding of the landscape of risks; that is to say, understanding which risks we are currently facing and which are on the horizon that pose an immediate or existential threat, their relative level of urgency, and how the impact of one risk can be interlinked to other risks.

The World Economic Forum (WEF) has laid fundamental groundwork in terms of analyzing global risks and risk perceptions, producing a regular update over the past 15 years. WEFs efforts in this space have undoubtedly played a pivotal role in characterizing the landscape of risk, especially representing perspectives from members of business and economic communities. Yet, this information can change depending on who and when you ask; this is why understanding risk *perceptions* from different perspectives and worldviews is so important (see, e.g., <u>Slovic et</u> <u>al., 1982; Rohrmann and Renn, 2000</u>). There is a need now to complement WEFs efforts and to represent a broader diversity of viewpoints when discussing risk (<u>Garschagen et al., 2020</u>). Thus, our work strives to capture **scientists' perceptions of global risks**.

This report shares the findings of the second iteration of the Global Risks Scientists' Perceptions survey. In repeating the exercise first conducted in 2019 (see Future Earth, 2020), the project team recognizes the importance of revisiting risk perceptions over time. In particular, given the manifestations of global risks which have taken place since 2019, and the two iterations of the WEF Global Risks Report (2020 and 2021), the time is ripe to reassess scientists' perceptions of global risks as a critical contribution to dialogues about potential solutions. This collaboration between Future Earth, Sustainability in the Digital Age, and the International Science Council (ISC) aims to contribute to the discourse that has been shaped through the WEF's important work with an international analysis of scientists' perceptions of global risks. In doing so, we hope to enrich the conversation around mitigation strategies already underway as well as to spark new and more inclusive dialogues.

Methodology

The 2021 Global Risks Scientists' Perceptions survey was open from June 16 to July 28, 2021. The invitation-only survey was sent to targeted groups with known membership (including scientists from all fields and disciplines, including natural, social, and human sciences) that have links to the organizations partnering on the project – Future Earth, Sustainability in the Digital Age, and International Science Council (ISC) – as well as to members of the International Observatory on the Social Impacts of AI and Digital Technology (OBVIA). These targeted groups include groups of "nominated experts" from Future Earth and International Science Council, who were either nominated by a peer or self-nominated through an outreach effort in May 2021 seeking to build a community around this survey work.

This rigorous dissemination strategy enables a clearer representation of the sample population. It also allows reporting on the precise number of individuals who received the survey as well

as the response rate by group (more details in Supplementary Material).

See Table 1 for an overview of the groups contacted and response rate by group. See the Supplementary Material for additional information on methodology and demographic data on survey respondents (219 complete responses in total, with expertise concentrated in environmental risks and, to a lesser extent, in societal risks).

Table 1. Population surveyed and response rate. Groups of known membership representing all scientific disciplines whose members were contacted to take the invitation-only survey.

Scientific community – Main groups surveyed	Response rate (%)
Future Earth	19%
International Science Council (ISC)	21%
International Observatory on the Social Impacts of AI and Digital Technology (OBVIA)	4%

The Global Risks Scientists' Perceptions survey employed the WEF definition of global risk, which is "an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years".

Based on discussions with the team of Advisors, and following the methodology of the 2019 Global Risks Scientists' Perceptions survey, the 2021 survey targeted respondents with at minimum a Masters degree or equivalent in the international science community from all fields and disciplines, including natural, social, and human sciences. Respondents were asked to: (a) evaluate the likelihood and potential negative impact over the next ten years for the Top 35 risks identified in the WEF Global Risks Report 2021 (see Table 2, where the language used in the survey to describe the Top 35 risks was taken directly from <u>WEF 2021</u>; results presented in section 1), (b) identify clusters of interconnected risks (section 1), and (c) identify any additional risks not covered in the Top 35 (results in section 2).

As per WEF 2021 methodology, evaluation of likelihood and potential negative impact were done using a Likert scale from 1 - 5, where 1 is "very unlikely" and 5 is "very likely" in the assessment of likelihood and 1 is "minimal" and 5 is "catastrophic" in the assessment of impact, and values between the extremes of the Likert scales were not assigned specific terms. Ethical approval for the survey was obtained through <u>Concordia University</u> Research Ethics Board (Certification Number: 30014702).

Table 2. WEF Top 35 Global Risks. From <u>WEF, 2021</u>. For the full WEF description of each risk, see Supplementary Material.

Risk Category	Global Risk		
Economic	Asset bubble burst in large economies		
	Collapse of a systemically important industry		
	Debt crises in large economies		
	Failure to stabilize price trajectories		
	Proliferation of illicit economic activity		
	Prolonged economic stagnation		
	Severe commodity shocks		
Environmental	Biodiversity loss and ecosystem collapse		
	Climate action failure		
	Extreme weather events		
	Human-made environmental damage		
	Major geophysical disasters		
	Natural resources crises		
Geopolitical	Collapse of a multilateral institution		
	Fracture of interstate relations		
	Geopolitization of strategic resources		
	Interstate conflict		

Table 2 cont. WEF Top 35 Global Risks. From <u>WEF, 2021</u>. For the full WEF description of each risk, see Supplementary Material.

Risk Category	Global Risk	
Geopolitical	State collapse	
	Terrorist attacks	
	Weapons of mass destruction	
Societal	Collapse or lack of social security systems	
	Employment and livelihood crises	
	Erosion off social cohesion	
	Failure of public infrastructure	
	Infectious diseases	
	Large-scale involuntary migration	
	Pervasive backlash against science	
	Severe mental health deterioration	
	Widespread youth disillusionment	
Technological	Adverse outcomes of technological advances	
	Breakdown of critical information infrastructure	
	Digital inequality	
	Digital power concentration	
	Failure of cybersecurity measures	
	Failure of technology governance	

Section 1. Scientists' Perceptions of Top 35 Global Risks

Top Global Risks

The survey found that scientists systematically ranked both likelihood and potential negative impact of the Top 35 global risks to be higher than WEF respondents.

This suggests a divergence in urgency to act, with surveyed scientists perceiving a higher degree of urgency to act to mitigate global risks across the evolving landscape. This echoes findings from the earlier Global Risks Scientists' Perception survey, where a significant gap between the two communities was observed (<u>Garschagen et al.,</u> <u>2020</u>).

Figure 1 presents these findings by risk category, showing the results for scientific survey respondents (darker circles) and WEF respondents (lighter circles), with each individual global risk connected by a grey line between the average values by respondent group.

Figure 1 also shows that, for all risks save two (*prolonged stagnation* and *debt crises*), surveyed scientists perceived both a higher likelihood and higher potential negative impact as compared to the WEF respondent group of business and economic communities.

Average responses are also shown in Figure 2, with results from surveyed scientists shown in Fig. 2A and WEF respondents in Fig. 2B. For each graph, the average likelihood across all evaluated risks is shown as a vertical line and the average potential negative impact is shown as a horizontal line. Comparing average likelihood and average impact across the two groups of respondents further drives home the fact that surveyed scientists perceived global risks to be, on average and nearly across the board, more likely and to have a higher potential negative impact.

It is notable that there was no major divergence observed between the two groups regarding the relative order of risks – by and large, the relative ranking of global risks was seen to be fairly similar across both communities.

In Figure 2, risks in the upper-right quadrant (highlighted in grey) have been ranked as aboveaverage with regards to both likelihood and potential negative impact, and can therefore be seen as the most urgent global risks to address.

Both communities – surveyed scientists and the WEF respondents – ranked Environmental Risks (plotted as green dots in Figure 2) as highly urgent and, unsurprisingly, *infectious disease* rose to become a highly ranked global risk in 2020-2021.

It is interesting to further note that risks located in the upper-right quadrant, which contains all of the environmental risks for surveyed scientists (Fig. 2A) and nearly all for WEF respondents (save *geophysical disasters*, Fig. 2B), represent issues that fit descriptions of systemic risks (see, e.g., <u>Renn et</u> al., 2020) that will require a high degree of global cooperation to address (though some risks in other quadrants likewise fit this description, it is notable that all those in the top-right quadrant do).

In some cases, most notably environmental risks such as *geophysical disasters* and *natural resource crises*, the higher perceived urgency (in terms of likelihood and impact) expressed by surveyed scientists as compared to WEF respondents is particularly pronounced, indicating a continuing divergence between perceptions in the scientific community and the WEF community in line with earlier findings (following <u>Garschagen et al., 2020</u>).

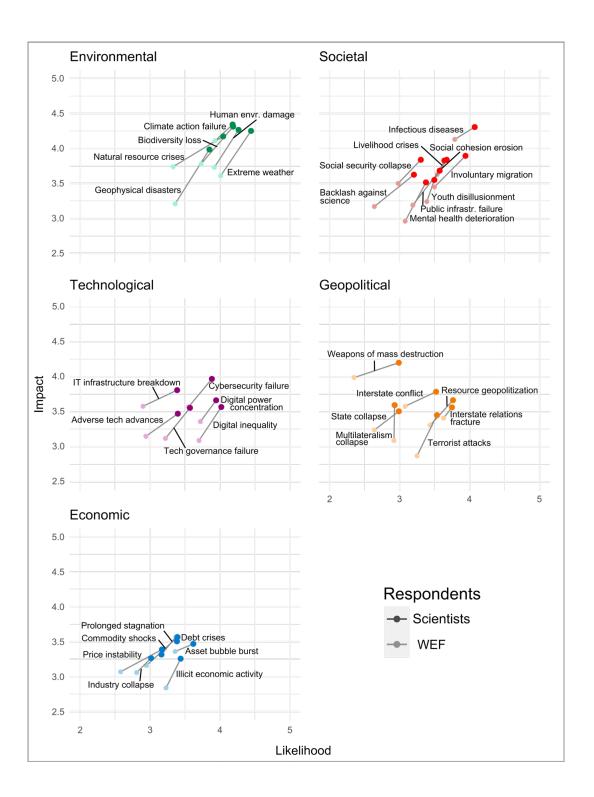


Figure 1. Gap in risk perceptions. Differences between respondents – surveyed scientists (darker circles) and WEF business community (lighter circles), organized into the five risk categories identified by WEF. Each point on the scatter plot represents the average likelihood (x-axis) and potential negative impact (impact, y-axis) for a given risk. Where the name of the risk could not be placed in such a way to make identification immediately obvious, a black line between the abbreviated risk name and the grey line linking surveyed scientists and WEF respondents responses was included. The risk categories are presented in order of the average ranking of likelihood and impact across both the surveyed scientists and WEF respondents: (1) Environmental Risks (avg. likelihood 3.9, avg. impact 4.0), (2) Societal Risks (avg. likelihood 3.4, avg. impact 3.5), (4) Geopolitical Risks (avg. likelihood 3.2, avg. impact 3.5), (5) Economic Risks (avg. likelihood 3.2, avg. impact 3.3).



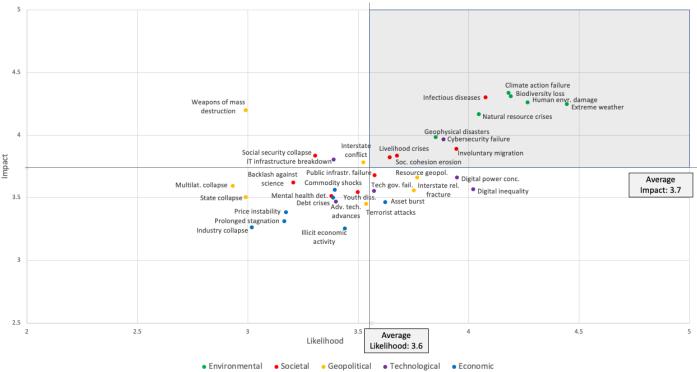


Figure 2B. WEF respondents

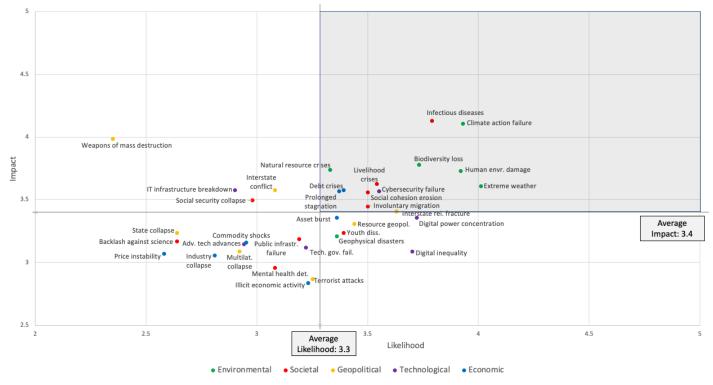


Figure 2. Comparing perceptions on likelihood and impact of global risks between science (Fig. 2A) and business (Fig. 2B). Responses from surveyed scientists to the 2021 Global Risks Scientists' Perceptions survey are shown in Fig. 2A and responses to the World Economic Forum (WEF) 2021 Global Risks Report are shown in Fig. 2B (data from <u>WEF 2021</u> and <u>Marsh McLennan 2021</u>). Both panels depict the average ranking of WEF's Top 35 Global Risks in terms of perceived likelihood (x-axis) and potential negative impact (y-axis) over the next 10 years. The colour of points represents the category of risks.

In a final ranking, some risks stood out more in terms of only likelihood or only potential negative impact from scientists' perspectives. The most urgent global risks to address were those where there is a confluence of likelihood and potential negative impact, though it is worth noting (as above) that these risks were also those that will require the greatest degree of global cooperation.

The top five risks listed by either variable in Table 3 are the same, though in slightly different order, indicating that these were perceived to be the most pressing and urgent risks requiring immediate attention: biodiversity loss, climate action failure, extreme weather, human environmental damage, and *infectious disease*. Three of these five -- *biodiversity* loss, climate action failure, and infectious disease – also emerged in the top five for WEF respondents (WEF 2021) for both likelihood and impact, further reinforcing the finding that these risks are of critical concern across sectors. In comparison with earlier results in the Risks Perceptions Report 2020, infectious disease and human environmental damage rose higher in the average rankings for both likelihood and impact. Extreme

weather remains the highest ranked global risk by likelihood, but fell lower on the average ranking of potential negative impact. Climate action failure remained stable at the fourth ranked global risk by likelihood, but rose to the top spot in terms of average ranking by potential negative impact.

Also notable is the fact that technological risks such as digital inequality and digital power concentration emerged as likely, but scientists did not rank these in the top 10 risks by impact. Compared to earlier findings, the average perception is that technological risks are now seen as more likely – they were not included in the top 10 risks for likelihood or impact in the Risks Perceptions Report 2020 (which presented results from the 2019 Global Risks Scientists' Perceptions survey). Meanwhile, perceptions from surveyed scientists regarding the likelihood of economic risks decreased over time and perceptions of both likelihood and impact of infectious disease increased. Similar to earlier findings, *weapons of* mass destruction stood out as having the lowest likelihood but a relatively high potential negative impact.



Table 3. Scientists' perceptions of the top 10 risks. Risks ranked by surveyed scientists, by average likelihood and potential negative impact over the next 10 years. The symbols indicate the movement of each risk in this ranking compared to previous results reported in the Risks Perceptions Report 2020 – where an upwards arrow indicates an increase in the ranking, downwards arrow indicates a decrease in the ranking, a circle with a dash indicates no movement (same ranking), and a circle with a star indicates a new risk in 2021 not included in the 2020 ranking at all.

Top Risks by Likelihood		Top Risks by Impact			
* Indicates that the risk also appears in the WEF top five ranked global risks by both likelihood and impact.					
1. Extreme weather	Θ	1. Climate action failure*	Î		
2. Human environmental damage	Î	2. Biodiversity loss*	Î		
3. Biodiversity loss*	Ļ	3. Infectious diseases*	Î		
4. Climate action failure*	Θ	4. Human environmental damage	Î		
5. Infectious diseases*	Î	5. Extreme weather	\downarrow		
6. Natural resource crises		6. Weapons of mass destruction	Î		
7. Digital inequality	Î	7. Natural resource crises	æ		
8. Digital power concentration	Î	8. Geophysical disasters	Θ		
9. Involuntary migration	↓	9. Cybersecurity failure	Î		
10. Cybersecurity failure	Î	10. Involuntary migration	Ļ		

Interconnected Risks

An important consideration with regards to global risks is understanding how they interact with one another. Risks do not occur in isolation. They can have compounding effects that amplify the impacts when two or more risks co-occur and they can also have cascading impacts, where the likelihood of further risks occurring increases once one particular risk manifests, creating a domino effect. Understanding the interconnections between global risks - including building awareness of interdependencies and feedback loops - and which groupings of risk present the greatest threats, is thus a key part of improving risk assessment and discussing potential solutions, since strong interconnections need to be taken into account in mitigation planning.

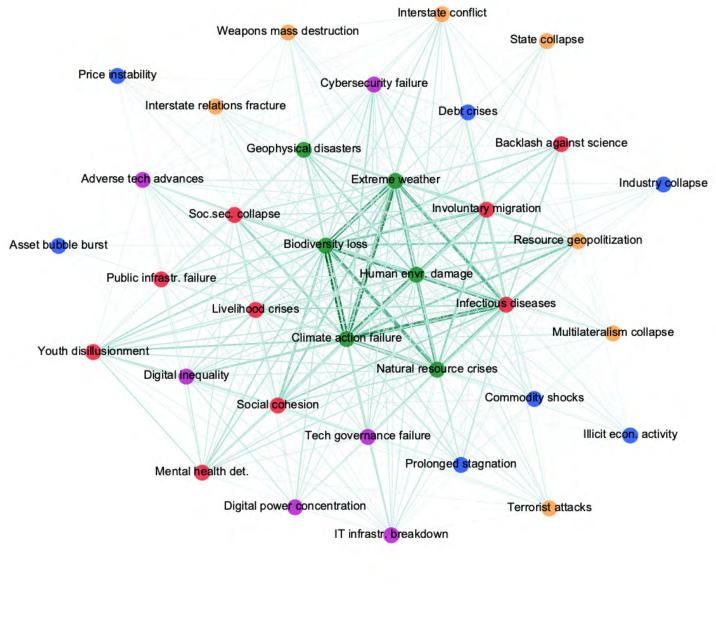
Figure 3 depicts the interconnections between risks as perceived by scientific survey respondents. Surveyed scientists identified five central risks as "most likely to have compounding effects and to lead to a global systemic crisis¹," forming an interconnected cluster of risks: climate action failure - biodiversity loss - infectious disease - extreme weather - human environmental damage (where risks are listed in order of how many times they were identified as interconnected with another risk). This shows a strong degree of interconnection amongst environmental risks and also points to a link between *infectious disease* – including, for example, the COVID-19 pandemic - and environmental risks. It is notable that the five interconnected risks identified are the same as those that were ranked as having the highest likelihood of occurrence within the next 10 years and the most severe

potential negative impact (Table 3), providing yet more evidence that these five risks are perceived to be the most urgent issues of our time.

The high degree of interconnections among environmental risks, coupled with the high degree of urgency associated with these risks as seen in Fig. 1 and Fig. 2A and 2B, suggests that environmental risks must be prioritized in dialogues around global risks and potential pathways to mitigate them. The high number of interlinkages between environmental and other categories of global risks also indicates that understanding environmental risks is central to understanding other categories of risk - including societal, geopolitical, technological, and economic risks. This supports previous findings that environmental risks play a key role in amplifying risk drivers and impacts by increasing the occurrence and severity of hazards, changing exposures, and amplifying vulnerability (see Keys <u>et al., 2019</u>).

Closely linked to the top five most highly interconnected risks are three additional global risks that could result in cascading impacts: *natural resource crises - involuntary migration - resource geopolitization*. These demonstrate the importance of considering interconnections across categories of risk, in this case highlighting the fact that social, geopolitical, and environmental factors have the potential to co-occur and lead to even larger impacts, potentially driving a broader cascade of risks, and also the central role that resource scarcity may play in the coming 10 years.

¹ Exact wording from GRSP 2021 survey in quotation and italics.



Environmental Societal Geopolitical Technological Economic

Figure 3. Interconnections between global risks. The nodes are coloured according to the risk category. The thickness of lines between nodes represents the strength of the interconnection. A thicker line indicates that the risks were mentioned in conjunction more frequently in response to the survey question asking which risks could interact and result in synergistic effects. The position of the nodes was determined using the Force Atlas algorithm in Gephi software, which creates a layout of relationships in a scale-free network.

Section 2. Scientists' Perceptions of Additional Risks Beyond Top 35

Spotlight on Inequality

As the landscape of risk evolves, it is critical to understand not only the likelihood and impact of previously considered risks, but to also explore risks which are either emerging or which may not have been perceived with sufficient urgency in the past to be included in the most recent WEF survey.

When asked to identify additional risks beyond the WEF Top 35, 55% of responses were categorized

as novel additional risks and categorized using Qualitative Content Analysis (see Supplementary Material for additional information on analysis; the remaining 45% of responses were categorized as nuances to the existing WEF Top 35 risks, see "The Need for Nuance" section below).

Of these, the risk of increased *inequality* dominated, representing 19% of all additional risks suggested, cited by 33 individuals (see Box 1 for definition).

Box 1. Definition of Inequality as the top-ranked additional risk.

Definition was written based on survey respondents' own words following the Qualitative Content Analysis of responses to the question on additional risks.



Inequality: The growing gap within and between nations and between generations regarding equitable access to resources including medicine, water, food, land, and other forms of wealth. This also includes inequality with regards to decisionmaking power, access to economic markets and healthcare, and issues around racial and gender discrimination.

Inequality was also the top ranked additional risk in our Risks Perceptions Report 2020, pointing towards a continued degree of urgency associated with this global risk. Indeed one important aspect of inequality, *income disparity*, was for many years included in WEFs list of Top Risks as an Economic Risk, and was the highest ranked risk by likelihood from 2012-2014. And while *income disparity* has not been included in WEFs top global risks since the <u>2014 Global Risks Report</u>, it is notable that facets of inequality (including, for example, digital inequality, unequal access to infrastrastructure, etc.) are still mentioned prominently across other risks in the WEF Top 35. Most importantly, our findings indicate that surveyed scientists highlighted the need to consider inequality as a standalone risk in risk assessments and risk perception analyses conducted by WEF and other groups, which would also serve to shed light on the interconnections between inequality and other global risks.

Other Additional Risks Identified by Scientists Beyond the Top 35

Although other additional risk categories were much more infrequently mentioned, we list the six next most frequently mentioned categories here to shed light on the diversity of perspectives and on emerging risks which may increase in prominence in coming years. The definitions for the additional risks listed below stem from the Qualitative Content Analysis of the survey responses and, to the extent possible, use respondents' own words. Of these six categories, all except for *spacerelated risks* were ranked as having above-average likelihood and potential negative impact, and most relate to governance and norms. The risk of *space-related risks* was ranked as having very high potential negative impact, but very low likelihood of occurrence.



Other additional risk categories listed in order of number of responses:



Shifts in culture & value systems: Loss of diversity in cultural, educational, and religious identities, accompanied or spurred on by the degradation or collapse of cultural and educational institutions and shifts in value systems.



Failure to account for synergistic risks: The occurrence of multiple risks in conjunction without proper planning, integrating multiple categories of risk and featuring severe, cascading consequences across spatial and temporal boundaries.



Erosion of democracy: The erosion of democratic principles, stability, and rule of law around the world, including the rise of authoritarian regimes and dictatorships as well as a rise in nationalist sentiments and cult-like leadership.



Lack of global collaboration and frameworks: A lack of coordination at the global scale due to insufficient collaboration and frameworks for engagement, including the failure of existing frameworks, such as the Sustainable Development Goals and One Health, as well as a deficit in leadership at the global scale.



Space-related risks: Events occurring outside of the Earth's atmosphere with impacts on Earth, including geomagnetic storms, space debris, and meteorites or asteroids.



Increased risks to public health: A rise in non-communicable disease and other health issues, such as poor nutrition, addiction, and auto-immune disorders, in conjunction with failures of public health care systems around the world that could also impact the WEF Top 35 risk *infectious disease*.

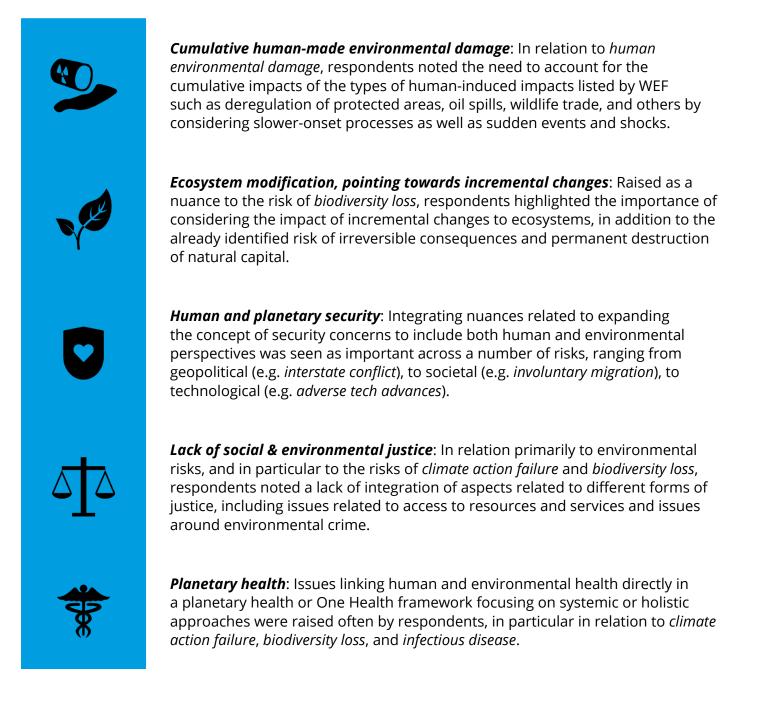
We observe that some of the additional risks identified by scientists in our previous survey did indeed appear in some form in WEFs Top 35. Notably, this includes the following of WEFs global risks: *mental health deterioration, social cohesion erosion,* and *public infrastructure failure*.

This indicates growing and shared concern for these risks across different communities, pointing to a continued need for cross-sectoral conversations about risks, since different communities can learn from one another regarding emerging risks and the changing landscape of risk. More specifically, different communities (such as scientists and business and economics communities) can identify similar sets of priority risks but can vary considerably on how to understand and address them (<u>Renn et al., 2020</u>).



The Need for Nuance

One important insight from scientists who responded to the 2021 Global Risks Scientists' Perceptions survey is that there is a need for a more nuanced approach to understanding global risks. Notably, many responses involved highlighting links between different global risks in WEFs Top 35. When asked to identify additional risks beyond the WEF Top 35, over one quarter of respondents suggested nuances to the description of the already-identified risks. Notable examples include:



Exploring the nuances highlighted by the scientific community drives home the need to take a systems approach to the assessment and analysis of global risks, and in particular to contextualizing the definition of risks within their broader socioeconomic and socio-ecological contexts. This further points to the need to ensure that decisions about the strategic management of risk must not be taken in isolation.

Future Directions

In a time where global risks are manifesting with increasing threat to human safety, it is time to sound the call more urgently than ever before for broader societal engagement and deliberation to mitigate risks. To effectively and fairly address global risks, a plurality of viewpoints must be represented in all circles making decisions on how to foresee, act on, and circumvent global threats.

Over the last 15 years, the work of WEF has been critical in raising the profile of global risks and highlighting perspectives from members of business and economic communities. Their efforts in this space paved the way for and directly inspired the Global Risks Scientists' Perceptions survey. But business and economic communities and scientists are only two groups of many more that are relevant to this discussion.

Moving forward, it is imperative to prioritize the engagement of groups such as youth, Indigenous populations around the world, farming communities and other rural populations, unions, and policy makers and authorities operating at different scales, to name but a few, to encourage inclusivity in discussions around global risks.

It will also be important to build on this risk perceptions work by expanding on the current analysis and incorporating additional elements of central relevance. In particular, exploring risk communication and risk governance as complementary dimensions to this work and analyzing factors that could explain divergence in risk perception will be important to integrate. Closely linked to these points is the need to further explore the concept of systemic risks in relation to risk perception, communication, and governance (following <u>Renn et al., 2020</u>).

As we near the end of the second year of the COVID-19 global pandemic and face a growing diversity of other urgent global risks, opportunities to learn from other perspectives and worldviews, to work together, and to find common ground have never seemed more important.

This report is intended to spark not only dialogues but concrete action. Our science community will continue to build on this initiative through a regular survey to study the evolution of global risk perceptions. We see this as central to building a broader community of practice and understanding around this theme and raising its profile globally. We also hope that the report inspires other groups to take stock of global risk perceptions within their communities and to share that information widely, engaging directly in dialogues around global risks and mitigation pathways across sectors, scales, and geographies.

Through collaborations, dialogue, and collective action, we believe it is possible to switch from the old VUCA, a world characterized by volatility, uncertainty, complexity, and ambiguity, towards a new VUCA state and a world increasingly characterized by vision, understanding, clarity, and agility (Johansen, 2017).

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